The CORNELL ENGINEER

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W YORK WORLD'S FAIR 1939
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by
Aaron [illegible] Sullivan, '38 EE

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Walt[illegible] J. Ryan, '06 AB CE

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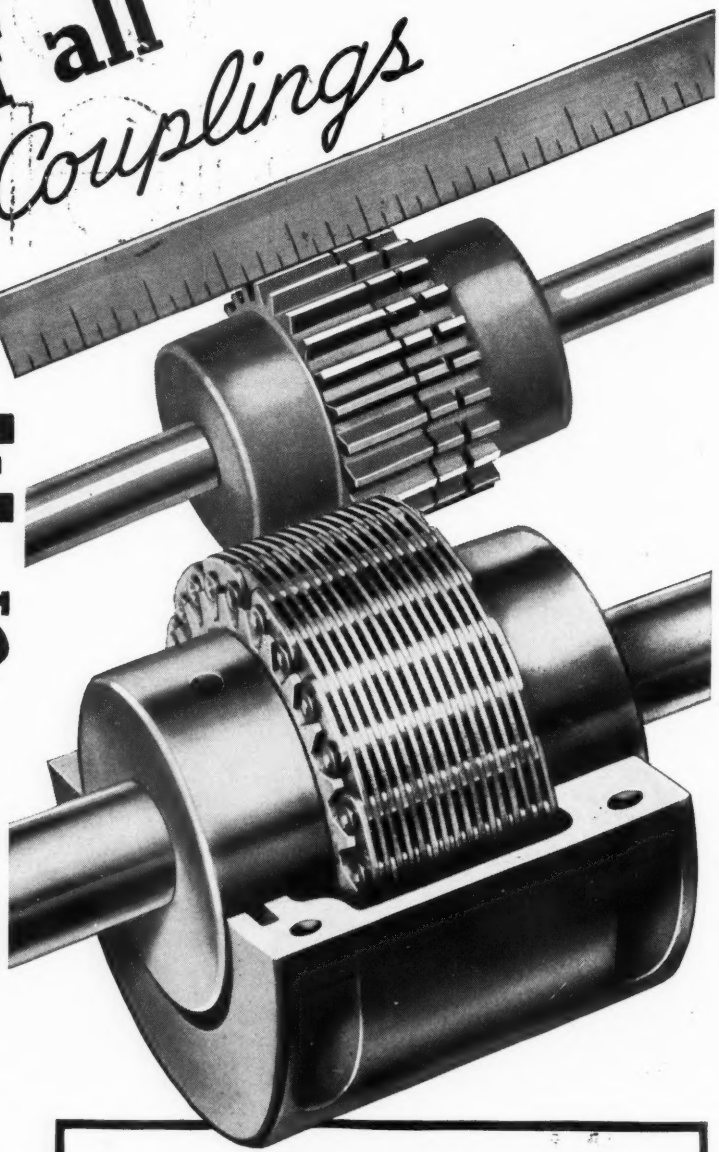

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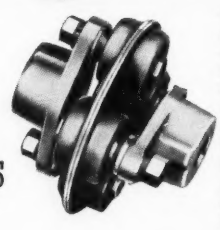

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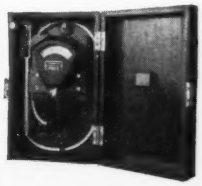

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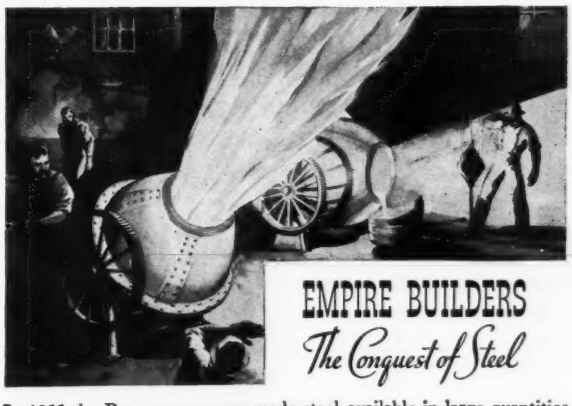

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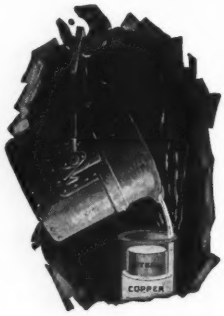

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THE CORNELL ENGINEER

PUBLISHED MONTHLY DURING THE COLLEGE YEAR

Volume 3 | MARCH, 1938 | Number 6

COMMENTS

Mr. Aaron H. Sullivan '38 EE discusses modern activity in television and the problems involved in resolving it into a practical commodity.

The history of the logging industry and its utilization of engineering is portrayed for us by Walter J. Ryan '06 AB CE.

Mr. Bohlke and Mr. Parkins, McMullen Research Scholars in Civil Engineering, describe an ingenius apparatus for measuring short light durations by the use of bullet photography.

Mr. R. H. Shreve '02 B. Arch., member of the Board of Design of the New York World's Fair, explains the major problems involved in planning the temporary city which will serve as teh site for 1939 Fair.

Mr. Barrett of our staff captures the striking beauty of Goldwin-Smith Hall for use in our cover illustration.

CONTENTS

Goldwin Smith Hall ..... Cover

Umpqua River Bridge ..... Frontis
Courtesy American Architect and Architecture

Seeing Is Believing 145
Aaron H. Sullivan, '38 EE

Logging 148
Walter J. Ryan, '06 AB, CE

Short Light Durations Measured by Bullet Photography 152
P. G. Bohlke and W. E. Parkins

New York World's Fair 1939 154
Richmond Harold Shreve, '02 B. Arch.

College Notes 162

Do You Know These Men? 164

Alumni Notes 165

President's Column 166

Stress and Strain 170

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—*Courtesy American Architect and Architecture*

Umpqua River Bridge

The CORNELL ENGINEER

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Seeing Is Believing

Aaron H. Sullivan, '38 EE.

The art of television is more than 50 years old. Yet during its half century of existence until 1935, television had failed to attain barely more than an abnormal childhood growth. Suddenly within a two-year period it has discovered that it has nearly come of age and is in reality a lusty, healthy adolescent, only waiting to try its strength. The engineers and physicists, who have sired it, claim that television is practically ready for domesticating by John Q. Public. At the present writing, the race is on between the various commercial interests to be the first in the field with a paying television system.

To explain why television has been so long in the development stage—why it has seen the start and growth of the present successful moving picture without itself reaching maturity—is to recount the entire history of television and the various technical difficulties in its path.

In the Beginning

The first steps toward television were taken by those pioneer experimenters and research workers who began to sort out the various relationships between electricity, magnetism, and light. It was Faraday (the same Faraday who was the godfather of present-day electrical engineering) who first discovered the relation between light and magnetism which caused rotation of the plane of polarization of a light beam passed through silica borate glass and subjected to a magnetic field. This effect was later utilized in a television system suggested by Nipkow.

The discovery by Becqueral in 1839 of the "light-electric effect" and its application to photo-cells by Hallwachs between 1888 and 1904, and Elster and Geitel from 1889 to 1913, began the television era. Their findings were applied to actual television systems by numerous inventors from about 1880 on. The flurry of experimental television work carried on at this time was due principally to the development of wire systems which were coming into use in connection with the telephone and telegraph. Even Graham Bell, the inventor of the telephone, had his ideas concerning transmission of visual signals as shown by certain "sealed papers" which he deposited with the Smithsonian Institution in 1880. Senlecq's mosaic screen was based on the selenium photo-resistance effect discovered by May in 1873. Ayrton, Perry and Carey also worked with the same material and Middleton conceived of a mosaic of thermo-couple elements for transmission purposes. From about 1900 to 1920, progress in television problems had seldom gone beyond the design stage due principally to the lack of adequate means of amplification of the televison signal.

With the advent of the vacuum tube about 1920, television began to progress in leaps and bounds. The amplification link in the chain was missing no longer. Two systems, that of Baird in England, and Jenkins in the United States, became outstanding. Both of these depended upon scanning of the subject by means of a rotating device which allowed impressions upon a photo-cell of each element of the subject. This was transmitted over a single channel and the picture put together at the receiving end by inversion. In 1928, Baird actually transmitted complete television images across the Atlantic, using a wave length of 45 meters.

And yet with all of this activity, televison failed to develop commercially. Most of the schemes were never tried, and those that were tried did not succeed well. It was all due to what might be termed low efficiency. The poor and unsatisfactory image obtained was in no way commensurate with the time, effort and expense required to build the television transmitter and receiver. The end did not justify the means, particularly when that end was a picture so crude as to be barely recognizable in most instances and requiring an expert at the controls to keep it from disappearing entirely. Thus, in spite of widespread advertising, television was not yet ready for its public.

How Does It Work?

In order to transmit a picture electrically, whether by wire or radio, it is necessary to explore or analyze the surface of the picture image, point by point, with some sort of a photo-electric device. Each point has a relative brightness which causes a current to be set

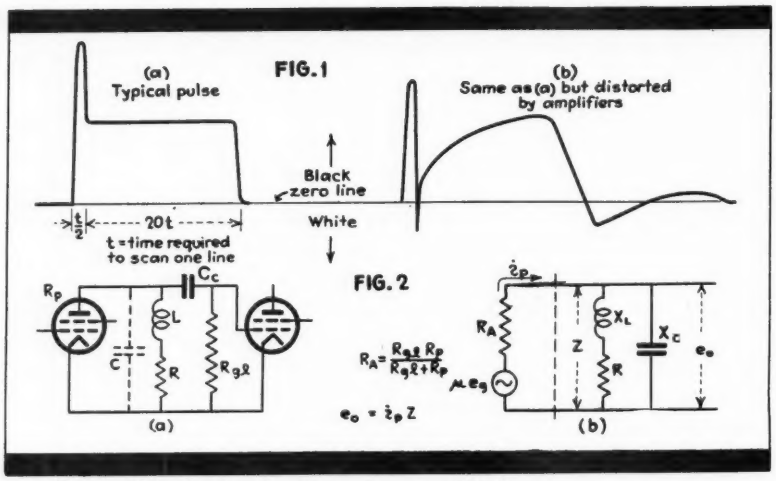


Fig. 1—Distortion Resulting From Poor Amplification.
Fig. 2—Actual and Equivalent Circuits of Video Amplifier.

up in the photo-electric cell which is proportional to the brightness of the point. By means of a scanning device, this exploration is carried out in a systematic manner. In the older mechanical scanning methods, such as the revolving Nipkow disc, the object is scanned by a series of apertures arranged in a spiral around the periphery of the disc. The chief objections to this type of scanning are the low sensitivity, the small size of the image in comparison with the size of the picture elements and the difficulty of synchronizing transmitter and receiver. This method has been displaced, except in certain specialized cases, by electronic methods of scanning.

It is obvious that the detail and faithfulness with which an image can be reproduced is dependent primarily upon the size of the elements of the picture. The difficulty of obtaining small-size elements has been one problem which has held back the development of television. The difference between a coarse grain and a fine grain picture may be observed in photographic work and in reproduction of photographs by means of electrotypes. In the same manner, a satisfactory method of producing television images must provide a large number of small elemental scanning areas so that the final reproduction may be viewed as a complete picture.

The modern means of scanning makes use of electron beam methods in both transmitter and receiver. At present, the two principal methods of scanning are those of Zworykin's "Iconoscope" and Farnsworth's "Image Dissector". These two methods or modifications of them are used both in this country and in Europe.

The iconoscope has, as its essential feature, a mica plate upon which an optical image is focussed. This mica plate has a surface composed of minute globules of photo-sensitive material which are insulated from each other. The rear of the mica plate has a metal coating which acts as one plate of a condenser. Since each globule loses electrons proportional to the intensity of illumination upon the particle (photo-electric effect), each globule is positively charged proportional to the intensity of the light falling upon it. If this mosaic of globules is scanned by an electron beam moving back and forth across its surface, its globule will receive electrons in turn when contacted by the electron beam and will discharge its positive charge through the condenser, this discharge being proportional to the illumniation of the particular globule. In this manner a varying current may be caused to flow through an external circuit, actuating an amplifier which will have an output signal representative of the scanning of the picture. At the present time, standard procedure is to scan the complete image 30 times per second (30 frames) and thus, by persistence of vision, to provide a moving

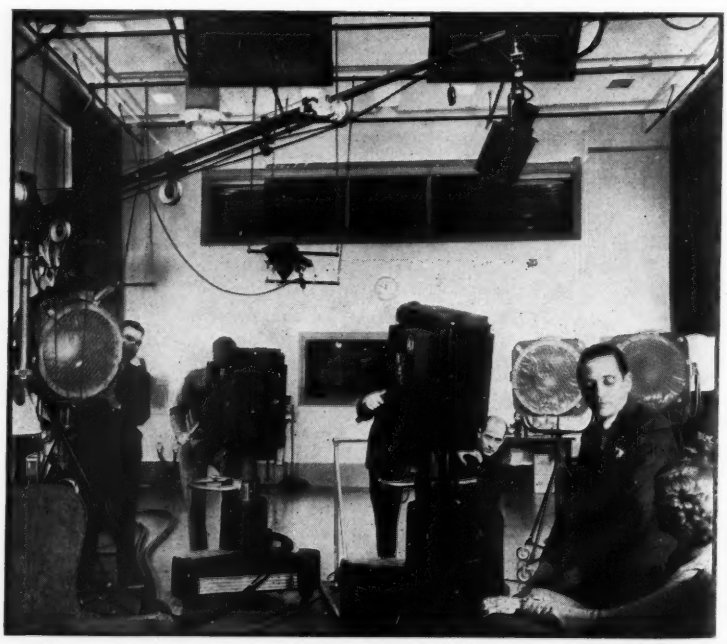


Fig. 3a—Televising A Scene In NBC Studio At Radio City, New York. Note Windshield Over Microphone To Reduce Air-Conditioning Noise.

image in the same manner that film frames apparently provide a moving picture. Each scanning itself requires the passage of the electron beam across the face of the mosaic 441 times (441 lines) or a grand total of 13,230 lines per second which would almost certainly overwork practically any known mechanical system. A 441-line standard represents approximately 275,000 picture elements, making for an entirely satisfactory detailed image.

Fig. 3b
Alexandria Palace Studio In London Telecasting A Scene With the Emitron Camera (Extreme Right)

The Image Dissector

Employing an entirely different system of scanning, Farnsworth's image dissector focusses an optical image on a photo-electric screen which emits electrons at each point proportional to light intensity at that spot. These electrons are focussed by a proper magnetic field into an electron image on a dissector plate. By changing the position of the field, this electron image is shifted back and forth across a scanning aperture in the dissector plate through which the electrons from the photo-electric screen may pass. This aperture is very small so that electrons passing through it are representative of an elemental area of the image on the photo-electric screen. In brief, the system consists not of scanning the image with the aperture but of scanning the aperture with the image. Electrons passing through the aperture are of course used to excite an amplifier whose output will therefore be representative of the picture scanning.

The Receiver

The present-day television receivers are all quite similar and are fundamentally an application of the cathode ray tube as it is used in the ordinary oscilloscope. Various methods are used to obtain proper scanning but whatever the method of scanning, it must be synchronized by some type of apparatus with the transmitted signal. The electron beam at the receiver scans across the fluorescent screen at the same rate as the electron beam at the transmitter analyzer and, impinging upon the fluorescent screen, produces a spot of light proportional to the intensity of the light from the original subject. Since this scanning occurs at the rate of thirty frames per second, the subject at the transmitter may move about freely and an accurate reproduction of the movements will apparently occur at the receiver due to persistence of vision. Figure 4 shows the oscillite cathode ray tube as used by Farnsworth.

Technical Features of Modern Television

Modern television presents technical problems entirely unlike those occurring in radio transmission of sound or telegraph signals, nor are these problems similar to those encountered in the early television work. In the first place, due to the transmission of such a large number of signals per second (each picture element constitutes a signal and each element must be repeated 30 times a second), a band of frequencies is necessary which is in excess of the present bandwidth required for broadcasting purposes. In 1929, a 60-line image containing about 4800 picture elements required a channel of about 63 kilocycles or approximately the same space as 12 broadcast stations. The present 441 line picture requires a channel of about 3,250 kc. or the same bandwidth as 650

(*Continued on page* 160)

Logging

WALTER J. RYAN, '06 AB, CE.
Logging Engineer, Weyerhaeuser Timber Co.

The history of logging in America dates back to the landing of the first settlers. Almost the first act in a new colony was to cut down trees for firewood and housing. For 300 years logging was a vital part of pioneering. Lumber was produced to utilize the timber cut from lands which were being acquired for agricultural purposes, and the product was used in the construction of a new nation.

By the beginning of this century our people realized that the supply of forest material was not unlimited and some thought was given to the future.

The United States government set aside forest reserves in the timberlands remaining in public control. Forestry began to gain a place in the thoughts of our government and in the curricula of some of our universities. The government built up the United States Forest Service and gave it the responsibility of managing these forest lands. The Service has developed a corps of technically trained men who have established a scientific program for the use and care of this national asset. The Pacific Logging Congress was organized in 1909 and includes operators, foresters and engineers. It has served as a medium for exchanging ideas and promoting technical development.

A generation ago the great body of timberlands which still remained in the hands of private owners was being logged with little thought of the possible future of the land, except to assume that it would all be absorbed by agriculture. The Department of Agriculture was urging the logger to seed the lands to grass and to put it in shape for producing agricultural crops. During the last few years there has come about a realization of the fact that most of these logged-off lands will never be required for farming and that they can best be utilized for the production of successive crops of timber.

The growing of timber on privately owned lands requires a change in the economic situation as far as provisions for taxation of the lands and the financing of the necessary protection, and it also requires important changes in logging methods and plans. These things are being worked out and the situation today is much different from what it was a few years ago and is still changing rapidly.

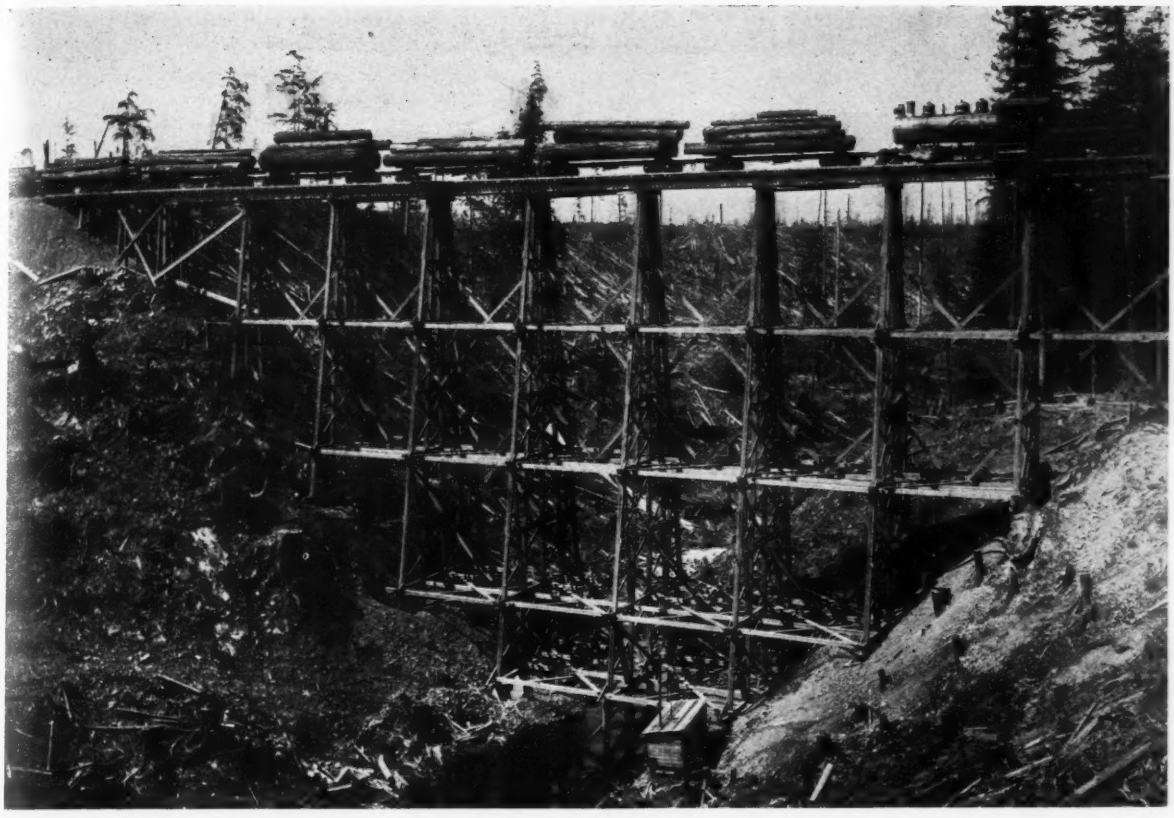
During the pioneer period, as the lumber industry was moving across the continent from its beginnings in Virginia and New England, through the Mississippi Valley and Lake States to the Pacific Coast, it depended largely on hand methods and horse power. When the Pacific Coast was reached, with its heavier timber and long distances from market, a new type of equipment was required. The Pacific Coast saw the development of steam power, electricity, and internal combustion engines in place of horses and bulls, the use of wire cable in place of chains and ropes, and the plans of technically trained men substituted for the strong-arm methods of the past.

The operation of logging is largely a problem of transportation. Ten percent of the cost is used in making the standing tree into logs, the process of cutting it down with a saw and bucking it up into lengths which can be handled. This work is done by hand and remains today practically the only handwork left in a modern logging operation. However, mechanical saws, in the form of a chain or blade, driven by electric motor or light gas engine, are being experimented with and it seems probable that within a few years they will be generally used in the woods. The other ninety percent of the cost is used in transporting the log to the mill.

It would be too large an undertaking to describe all of the various styles and types of equipment which are used for this transportation under different circumstances and conditions, but it might be of interest to go over, hastily, the history of one operation in the Puget Sound district (State of Washington) as being a typical example of what is being done.

The Snoqualmie Falls Lumber Company was organized in 1914 by two corporations owning timber within an area 8 miles by 16 miles in extent, lying approximately 30 miles east of Seattle, at the foot of the Cascade Mountains, and immediately adjoining the Snoqualmie National Forest.

During the year preceding the organization of the new company, cruisers were sent into the field to estimate the amount of timber standing on the lands, amounting in all to about 45,000 acres. These lands could not be reached by wagon road and were crossed by only a few miles of trail suitable for travel by pack horse. This cruising was done by parties of two men each who ran strips across each section at intervals of 440 feet, one man using the compass and carrying his distances by pacing, while the other estimated the amount of timber on the area. These estimates of



High Timber Trestle On The Logging Railroad

timber were used in determining the value of the properties and the capacity to be provided for an estimated life of 20 years.

During the next year, engineering work was started by locating a mill site and making preliminary surveys for a railroad from the site, which had been chosen on the bank of the Snoqualmie River, into the timber. This main line railroad was located with a maximum 3% grade and 12 degree curvature and in about six miles of distance reached the location chosen for the first logging camp on bench lands 600 feet above the mill site at an elevation of approximately 1000 feet.

During the following year, railroad construction was started and a contour map was made of the timberland area on the scale of 200 feet to the inch with 10-foot contours. This mapping was done by methods similar to that used by the cruisers. The compassman kept track of the distance while the topographer carried an aneroid barometer and sketched the contours in the field. His aneroid barometer elevations were checked at intervals of one mile by stations on lines which had previously been run with a transit and elevations determined with a "Y" level or with vertical arc readings on the transit line. The corrections in the aneroid elevations were made by reference to a barograph. The elevations were corrected and placed on the map and the field sketch contours were used by the office draftsmen to indicate the shape of the country in putting the final contours on the map to fit the adjusted elevations.

A newer method of map making is by the use of an Abney level and a 300 foot chain. Under this slope chain method the sketching is frequently done by a separate party which goes into the field after the entire section has been covered by chaining parties which have marked their stations on the ground by stakes or metal flags. The sketcher then has elevations of points on the strips which are from 330 to 660 feet apart and at intervals of approximately 200 feet along the strip. With the entire section thus covered with elevations he is able to sketch his topography accurately in the field. This system has largely superseded the use of plain table, stadia, and aneroid barometer surveys.

The problem of railroad location for a logging operation is different from that of a main line route in that it is necessary to serve the entire area with railroad lines at such distance apart as to allow timber to be economically yarded to the railroad. For this reason the railroads are located to cover the area as a sort of gridiron rather than to chose the best route through the district. This required about five miles of rail-

road per section of land and, as more than three sections were to be cut each year it meant about fifteen miles of railroad built annually with a life of one to four years. The contour map of the entire area was used in determining the proper locations for these railroads.

By the time the sawmill was completed and ready for operation, the main line railroad had been constructed and about 20 miles of branch lines and spurs built, on which were located two logging camps. The problems of railroad construction are those of the railroad engineer on our pioneer railroads and are quite different from those of the modern heavy reconstruction projects. The temporary nature of most of the line requires cheap construction, but heavy loads require strength. Sharp curves, heavy grades, and narrow roadbeds with heavily tied and well ballasted track are the result. The presence of cheap timber has produced some very interesting bridges in crossing deep canyons with high trestles and spans up to 80 feet on girders of logs.

The railroad locomotives were small Mikado type machines of a tractive effort of about 30,000 pounds, together with two geared locomotives for use on spurs where it became necessary to use grades as steep as 6% and curves as sharp as 30 degrees.

The equipment purchased for bringing the logs to the railroad consisted of six steam donkey engines, known as yarders, and six duplex loaders. These were equipped with three drums each and the yarders were supplied with about 1000 feet of 1⅛″ plow steel wire rope cable and 2000 feet of ⅞″ line for haul back. Wire rope is an important part of the equipment of a logging operation and the engineers of the rope manufacturers have probably given more thought to satisfying the requirements of this industry than to all others combined. All types of construction and kinds of wire have been used in an effort to meet the exceedingly severe demands made upon logging ropes, but Seale construction, plow steel grade, remains the standard for most purposes.

80-Foot Timber Girder Span.

The first logs were handled by ground yarding, which consisted in drawing the cable into the woods by means of a light line pulled out by hand, attaching the main line to a "choker" which has been placed around the log, and dragging the log over the ground towards the donkey engine. This system of logging was soon replaced by the High Lead system in which the line was led from the donkey through a block hung 150 feet in the air, on a tree beside the track. These "spar" trees were rigged where they grew in the forest if possible, but in many cases were either moved upright, as much as 150 feet, to the track, or were hauled in by train and raised in position. The topping of these standing trees and placing the necessary guy lines and blocks upon them, is one of the most spectacular parts of the logging operation.

The first of this steam equipment to be purchased was designed to burn wood fuel, but it was soon changed to burn fuel oil. The cost of the wood fuel, in labor and in timber consumed, and the additional fire hazzard from the sparks, justified the use of the more expensive fuel.

About this time the price of fuel oil took an advance and, as electricity was being used exclusively for power at the sawmill, the management became interested in trying to adapt the logging equipment to electric operation. The first unit was built with a 200 HP motor replacing the steam engine and operated successfully for about a year, when an order was placed for six units of 300 HP motors for the main yarders and two 75 HP motors on the duplex loaders. A yarding and loading unit were mounted on the heavy sled and moved from one location to another on specially designed moving cars. The total weight of each unit was 65 tons.

One other electric unit about twice as heavy was added to this equipment a few years later, called a "skidder." The operation of the skidder is similar to the High Lead yarder except that it was built with a 400 HP motor, and additional drums were provided to handle a "skyline." This 2″ skyline cable was put in position between the top of the spar tree and a tail tree, selected at a distance of 1200 to 1800 feet back from the railroad, and the main line was carried through a carriage which ran on this skyline, making a cable-way conveyor for bringing in the logs, allowing higher speeds and longer distances than were possible on the High Lead.

This electric equipment is still in use but it has been supplemented during the past few years by smaller units of gasoline engine powered donkeys of 125 to 250 horsepower, a diesel-driven donkey with 300 horse-

power, and during the past year with tractors. One of the tractors is equipped with a bulldozer, which is used to clear roads from the landing into the timber, and each of the tractors has an "arch" which is a fair leader carried about ten feet above the ground and through which a wire rope is led from a hoist on the tractor. This cable is unspooled in the woods and hooked to the chokers around the logs. When it is pulled in, the forward end of the log is raised off the ground and the tractor drags the load to the landing where it is dropped and picked up by the loading engine and placed on the cars.

The cars used for hauling these logs are built on standard 80,000-pound capacity trucks but have no deck. A log bunk is set over the center of the car trucks. The trucks are connected by timber sills 30 inches in width. The principal object of this is to eliminate the weight of the additional timber in the deck, together with the trash and dirt which would accumulate upon it, and to avoid the damage which would be done by falling logs and chunks. The logs are hauled from the landing by switch engines and assembled in trains which are hauled to the log dump at the mill. At the mill, they are pushed from the cars by an unloader which has a push arm and sufficient throw to slide the logs from the bunk over a brow log and into the water.

In addition to these logs which come to the mill from the company's own operations, they frequently purchase logs from small operators in the district who load their logs on auto trucks and trailers and bring them to the same log pond, where they are handled with the company's logs. The methods employed by these small operators are quite similar, although they usually have smaller and more portable equipment.

The logs are fed from this log pond into the mill by pushing them around by hand or allowing them to drift with the wind. A great many of the logging operators in the Northwest are not connected directly with sawmills but sell their logs on the open market. Their operations are located on tide water, largely in the Puget Sound area and along the Columbia River, and their logs are put into rafts which are towed about by tugboats. These rafts are merely loose logs held together by broomsticks, but where the towing is to go into the ocean, the logs are built up in cradles to a solid block of timber held together by chains, or each individual log is bored and tied to its neighbor with a log chain.

This hasty sketch should serve to give some idea of the problems connected with this industry which is so intimately associated with natural forces, problems that must be worked out without full consideration of all the rules of engineering. Much of the equipment has just grown into use rather than been designed for its purpose, but the last few years have

A High Lead Logging Operation Showing The Spar Tree And Cables.

seen great progress in more efficient planning and design and the waste that has necessarily occurred in part of the process is being rapidly eliminated.

During the early years of the operation at Snoqualmie Falls, it was assumed that all of the lands logged off would be required for agriculture. No thought was given to their care except to attempt to burn off enough of the refuse from logging to prevent its becoming a fire hazard to the operation. It is now becoming apparent that these lands have a much higher economic use in raising another crop of timber than they could possibly have as agricultural lands. As a result of this understanding, the present method of logging is providing that these lands should be left in such condition that a new forest can grow. This is done by burning off the slash each season at the end of the summer. The timber in the adjoining areas will furnish seed for a new crop and where it will not be possible for the cut-over land to be reseeded from adjacent standing timber, groups of seed trees are left growing in places where they can be protected from fire and wind.

This system will provide a restocking of the forest lands under most circumstances, but in order to care for any area which may be denuded by recurring forest fire or by other damage which might occur, the Snoqualmie Falls Lumber Company is now establishing a tree nursery to provide young seedlings to replant areas where it may become desirable.

Whereas, twenty years ago, the plant was built for a twenty-year life, it is now being operated on the basis of continuous production. By purchase of additional timber from adjacent owners and from the Forest Service, there will be enough old growth timber available to supply the mill until a new crop is ready to harvest. This old growth timber is not producing as much by growth as it is losing through

decay, but the growth of the young forest will average a thousand board feet of timber on an acre each year until it reaches maturity.

Trees are today the source of fuel, structural material and paper, and the chemical engineers are rapidly developing processes for their use for textiles, foods, and plastics. In fact, it is easy to conceive civilization continuing on this planet until the supplies of minerals are exhausted. Then civilization must depend upon the forests as did our ancestors.

In the past, we have worked our forests as mines of timber to be exhausted and abandoned, or we have set them aside as parks to be a continuing care and expense, with no economic return. Our generation is to see the forests of America converted into perpetual sources of raw material.

Short Light Durations Measured by Bullet Photography

P. G. Bohlke and W. G. Parkins
McMullen Research Scholars

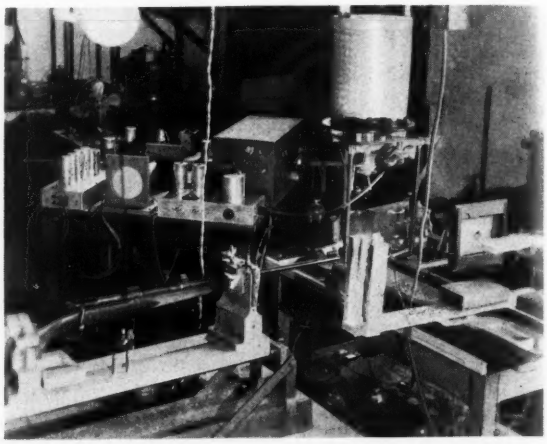


Fig. 1—Apparatus Used For Obtaining Photographs Of Bullets In Flight.

The duration of light intensity emitted from a damped electric spark may be readily determined by photographing high velocity bullets. The present note deals with recent measurements made during the course of an investigation of dynamic photoelastic phenomena.

In the October, 1937 Cornell Engineer, an article by Dr. T. R. Cuykendall was accompanied by some pictures obtained of elastic waves traveling in a photoelastic material. It is known that such waves travel with the speed of sound in the particular material. Since this represents a comparatively high velocity, photography of these elastic waves was only accomplished by exposures of extremely short duration. This was made possible by using an electric spark as a light source. A condenser was charged to 30 kilovolts to furnish the electrical energy for the spark, and obviously the characteristics of such a spark depend upon the constants of its circuit. Here, if the spark were to last ten millionths of a second (10 microseconds), the elastic wave would have traveled about one-half inch and consequently produced an equivalent blur on the film. In the interpretation of the photographs of the elastic waves, it became necessary to know with reasonable accuracy the duration of the exposure.

There are many methods for determining the properties of short-duration light phenomena. A notable example is the Kerr cell which, while capable of high precision, requires rather complicated auxilliary apparatus. A logical and easy solution to such a problem is to photograph some high speed object of which the size and velocity are known. Such an object may be a high speed bullet which has the great advantage of being immediately ready for use and readily obtained. The particular difficulty with this method is to control the light source so that the exposure will be made when the projectile is in the field of the camera. There are numerous means for accomplishing this. The device for the measurement of very short time intervals, described by Dr. Cuykendall in the previously mentioned article, is ideal for this purpose. Not only does this timer permit precise control of the instant of exposure, but also it provides a means for ascertaining the velocity of each individual shell. The rifle is placed in a machine rest and the bullet directed so as to break a hair wire in the circuit of the timing device. This constituted "event 1". "Event 2" was the instant the photograph was taken; the latter showed the bullet in flight beside a transparent centimeter scale giving the distance traveled between events. The time between events was indicated on the timer by the number of degrees traced out on a cathode ray tube by a circular sweep of known frequency. Thus by knowing the distance traveled in a certain time, the velocity follows.

Fig. 1. is a general view of the apparatus. Circuits used in conjunction with the timer are on the far table; the condenser is the cylindrical container above; the spark electrodes are directly beneath this condenser; and a .220 Swift rifle is in the foreground. The camera is just out of sight to the right of the picture. This arrangement shows that only silhouette photographs were taken. Use of reflected light would reduce the intensity considerably. The first trials were made using ordinary .22 long-rifle shells which have a rated muzzle velocity of 1430 feet per second; however, insufficient blurring made quantitative results impossible and further trials were made with .220 Swift cartridges, the fastest commercial bullet available and having a muzzle velocity of 4140 feet per second. Fig. 2 is a photograph obtained of such a shell in flight.

To obtain more accurate information from such a photograph, a microphotometer trace was made of the negative. A microphotometer fundamentally consists of a steady pencil of light projected thru the film to be measured onto a sensitive thermopile connected to a galvanometer. As the film is moved gradually along by a high quality screw, the galvanometer deflects in accordance with the density of the film at the point subjected to the thin pencil of light. The microphotometer trace consists of a photographic recording made by light reflected from the mirror on the galvanometer suspension to a strip of sensitized paper being steadily advanced. Such a trace is shown in Fig. 4.

Analyses of such traces taken in the region of the nose and of the tail of the bullet show that the intensity emitted is not symmetrical as a function of time. From the character of such traces as the one in Fig. 4, it may be easily shown that the light intensity rose suddenly, rounded off at a maximum, and decreased relatively slowly in a decay curve. As there is no blurring widthwise due to the movement of the projectile, traces taken in this direction provide information for making instrument corrections. Calculations from the traces of several photographs taken with this spark source result in an exposure time of the photographs of 1.2 microseconds, but it is to be remembered

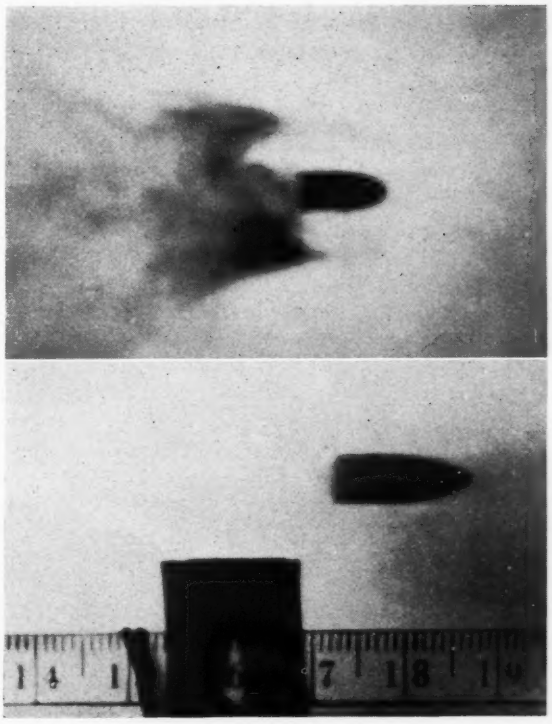


Fig. 2 (above) .22 Hi Speed Shell About 8 Inches From The End.
Fig. 3 (below) .220 Swift Shell Traveling With A Velocity Of Approximately 4140 Feet Per Second.

that photographic density (assuming the reciprocity law) is proportional to the effective area under the light intensity-time curve described above. Hence the long tail on this curve will have relatively small photographic importance. Neglecting this tail, the spark source has an effective duration of 0.8 microseconds. This means that the sphere of confusion in the photographs of elastic waves, referred to before, is of the order of 1/25 of an inch. This is sufficiently small for accurate measurements.

The authors wish to acknowledge a grant from the John McMullen Fund which has made this work possible. Also they wish to express appreciation to Dr. T. R. Cuykendall for his many valuable suggestions and discussions, and to Mr. F. H. Woodcock of Seneca Sporting Goods for the loan of his .220 Swift rifle.

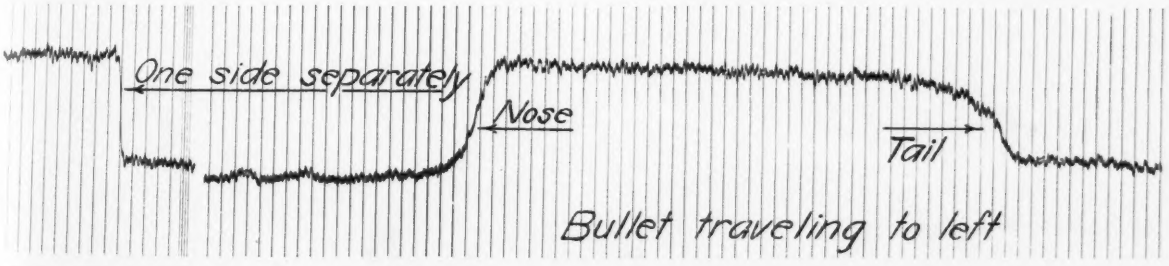


Fig. 4—Microphotometer Trace Of The Bullet Shown In Fig. 3, Where The Distance Between Vertical Lines Is .38 mm. On The Scale Below The Bullet (This trace is one-seventh original size)

New York World's Fair 1939

by Richmond Harold Shreve, '02 B. Arch.

WHEN the members of the Board of Design of the New York World's Fair 1939 were asked in the early summer of 1936 to prepare a plan for the Fair and to have their report in the hands of the President and the Board of Directors by September 1st of that year, there was presented to the members of the Board of Design a problem which was probably unlike any which they or others engaged in a similiar task had had to deal with.

At the time there existed on Long Island in the center of the City of New York, an area which for many years had been known as the Flushing Meadows, a great marsh used by the City of Brooklyn and other adjoining communities as a sink into which their rubbish could be dumped. Through this site Flushing Creek meandered, flooding the loosely packed bog over which the dump had been extended year by year. Within and upon this somewhat more than twelve hundred acres of swampland was to be placed a City which would exist for a year or two and then be removed. In its brief life span of perhaps five years from birth to destruction, and not more than twelve months of mature existence, it would be visited by people numbering almost a half of the population of the United States. On special occasions this City might in a single day receive, entertain, and dismiss from half to three-quarters of a million of persons. Throughout the active life of the City there would be need to provide, maintain and operate suitable transportation to and from the site, means of access through controlled admission gates, adequate circulation for transportation vehicles and for pedestrians, and provision for shelter, food, education and recreation. Underlying all design and development work was the agreement that at the termination of the Fair, when the City had breathed its last, all evidence of its temporary existence would have to be removed, even to a depth 4 feet below grade, the site then to be reconstructed as Flushing Meadows Park, and the whole returned to the residuary legatee, the City of New York. The time allowed to accomplish the preparation of this plan, the development of the Theme, and the estimate of the cost of completing and operating the Fair was barely more than three months, a busy summer holiday.

EDITOR'S NOTE:—*The author is a partner in the firm of Shreve, Lamb and Harmon, Architects, of New York City. In his official capacity as a member of the Board of Design for the New York World's Fair, he is best able to give us the planning and architectural problems involved in this great project. In our April issue we shall publish an article by Mr. H. A. Foster, Engineer in charge of Construction, containing an interesting analysis of the very unusual engineering difficulties involved in carrying the project through.*

The problem was circumscribed by many limiting conditions which in general were associated with the three objectives just named. The first of these objectives was necessarily the Theme, a statement of the philosophy governing the development and realization of the whole project, constituting a spiritual control by which other purposes must be guided, and within which the great conception must be framed. The Theme, "Building the World of Tomorrow," is to be particularized through a Theme Exhibit in the Perisphere, the center of interest of the Fair, and through related Focal Exhibits set up at secondary but major points in the areas of special interest, Shelter, Food, Transportation, Means of Production, etc., which together form the central element of the general plan. The expression of this spiritual pattern in its physical form was limited by a set of material conditions, many of which are noted on the accompanying Figure 1. These are the demands of realism, and as such are of particular interest because of the direct response which is made to them in the physical plan.

There are shown by the outer solid line (Figure 1) the limits of the areas leased by the City of New York to the World's Fair Corporation. It will be seen that there are a number of major separate divisions due to the I.R.T. and B.M.T. subways and the Long Island Railroad, and to Horace Harding Boulevard, all of which cross the site generally in an east and west direction, and to Grand Central Parkway Extension which forms the western boundary of the site and divides into two sections the important area on which the main element of the general plan has been developed.

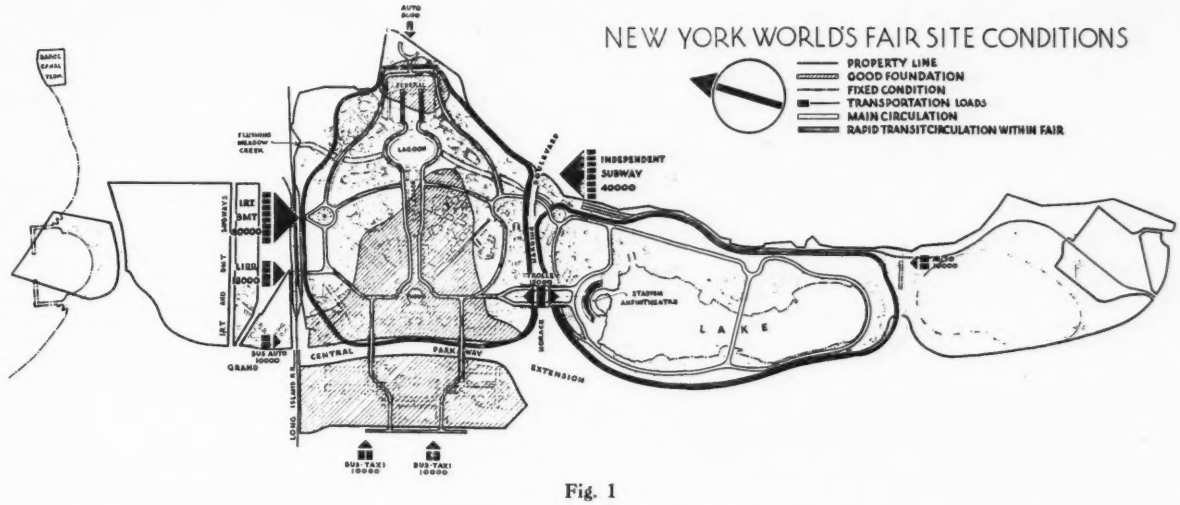


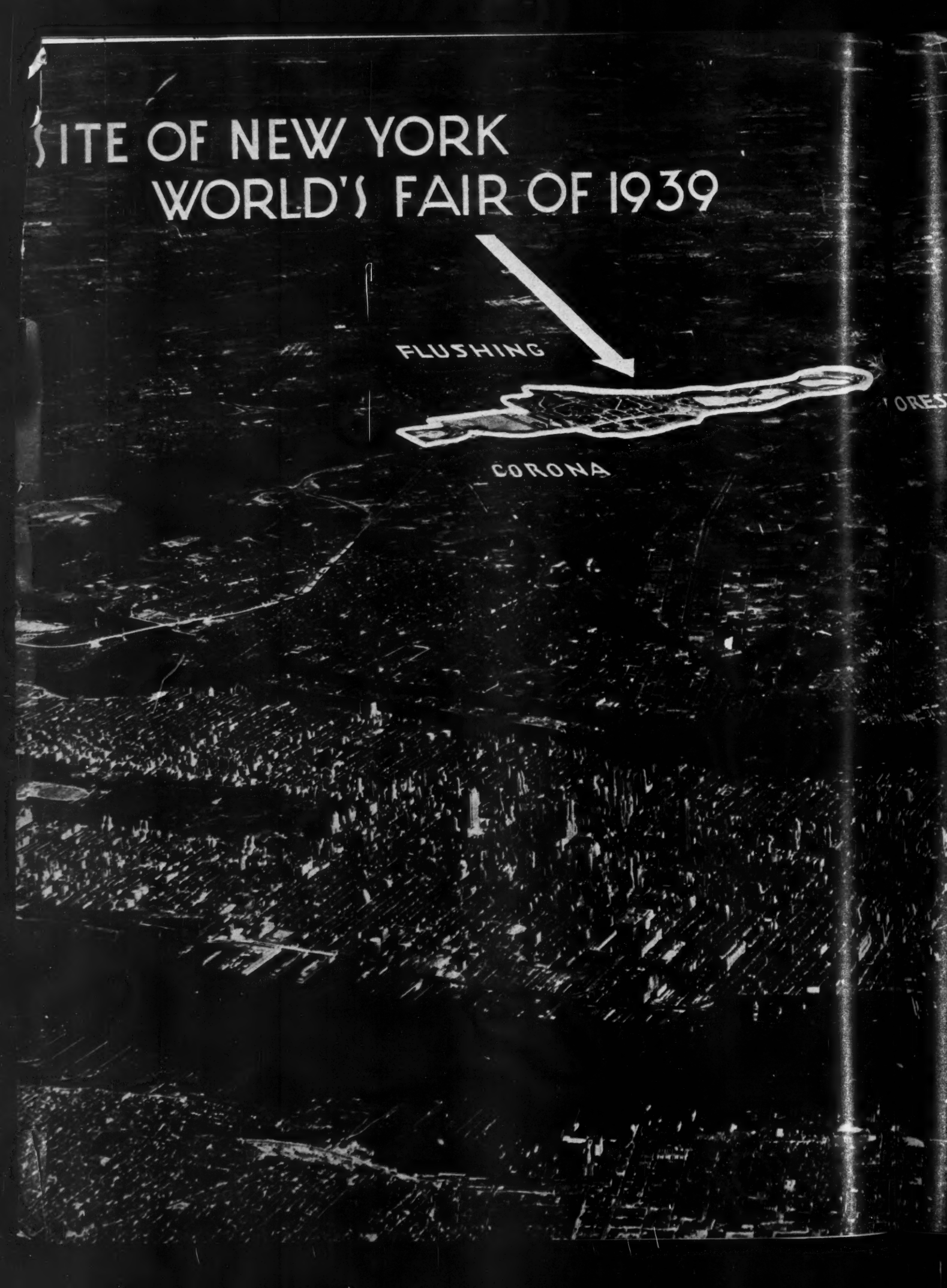
Fig. 1

The great distances, over a mile east and west, and over three miles from north to south, point to the necessity of compactness in design. The cross-hatched areas in the central section of the site show where the accumulation of rubbish deposited through the years has penetrated and compacted the soil, making a more secure foundation than exists elsewhere. By cutting down the high points of the deposited material and dragging out the areas in which the lakes are to be formed, a surface practically level, having a rise nowhere greater than 25 feet, is possible. Through the site, generally from south to north, runs Flushing Creek, extending along the easterly side of the central section to its outlet in Flushing Bay. Midway of the central section at a point between the two cross-hatched areas of fill, the creek forms a lagoon inviting special water treatment at this point.

The transportation terminals and main entrances at which arrivals and departures will occur and the estimated number of arrivals per hour at each point are shown by the black arrowheads and the accompanying figures. It will be seen that the dominant points for admissions are two, one on either side of the central area, and directly related to the subways on either side. Minor arrivals, meaning 10,000 or less per hour, are indicated in relation to buses, taxis, automobiles and trolleys. Once this great population has been admitted, provision must be made for free and reasonably direct circulation to the interesting sections of the Fair. The vehicular routes of peripheral bus lines are shown in the illustration as essential elements of the governing conditions. Whether this transportation is to be by railroad, or bus, taxis, or auto-trains, is unimportant; it is sufficent for the moment to know that by loop routes of some such type, general circulation must be provided with internal connecting lines for cross-plan traffic.

The means of crossing the highways between sec-

Fig. 2—Preliminary Plan of World's Fair as of August, 1936.


SITE OF NEW YORK
WORLD'S FAIR OF 1939
FLUSHING
CORONA

JONES BEACH
LONG BEAC
OREST HILLS

Fig. 3. #1 is the Administration Building which has been occupied since August of last year and from which the work of the construction of the Fair is now directed. #5 is the Theme Center from which the Esplanade extends to the left between Buildings #7 and #8, and between sites #10 and #11 until it reaches the Lagoon which is evident in the course of Flushing Creek. The distance along this axis of the Fair is a mile and one-quarter. Across the Theme Center at right angles with the Esplanade, extending from Building #2 toward Bridge #22, are the Plazas on either side of the Theme Center. Bridge #22 crosses Horace Harding Boulevard. At #24-A is one of the bridges over Grand Central Parkway Extension which passes along the right lower corner of the photograph, finally passing under the Long Island Railway at bottom-center of photograph. The distance between the Long Island Railway (#25) and the Horace Harding Boulevard (#22) is approximately three-quarters of a mile.

tions of the site become controlling factors in this circulation. The locations of the two overpasses across Grand Central Parkway Extension are fixed by the grade level of the boulevard itself and the height above it to which the banks of the fill rise on either side. Only at the two points shown are the bridge-heads high enough to permit the overpass without depressing the boulevard. The overpass between the two sections of the Fair on either side of Horace Harding Boulevard fixes a dominant north and south axis, and the underpass at the easterly end of the Boulevard where it rises above the internal circulation, is a further control in fixing the main pathways.

The Board had then to devise a plan subject to all the limitations imposed by property lines and levels, external highways and internal circulation, foundation conditions, water routes, the points of access and departure fixed by the railroads, and numerous other practical factors. It will be seen by reference to Figure 2, showing the general plan submitted with the first report of the Board, how naturally and logically the development of the plan responds to the influence of what the French call the "donnés", or the given conditions within which the project must be developed. The chief points of arrival and departure on the right and left of the principal area fix centers at which ample space must be available, and to and from which the major streams of traffic must flow. Midway between lies the great Esplanade, planted with sheltering trees, embellished with quiet water, a restful broad avenue reaching from the Lagoon on its easterly end to the Theme Plaza on the west, the emotional center of the Fair. Here the Esplanade joins the north and south plazas from which extends the avenue crossing the bridge over Horace Harding Boulevard to give access to the Amphitheatre at the north end of the lake. Radiating from the Theme Center, diagonal avenues provide direct circulation to the two main points of ar-

rival. Between the two points of arrival swings the curved avenue crossing the Esplanade near the Lagoon. Over this broad highway, for pedestrian and vehicular traffic, will pass many who come from the amusement center alongside the lake past the Independent subway station south of Horace Harding Boulevard, to reach the Long Island railway and the I.R.T. and B.M.T. subways on the north. At the lower portion of the drawing is the Transportation section facing the City Building from across Grand Central Parkway Extension over which the two wide bridges have been set up. Across the Lagoon to the east is the Government center for the Federal buildings and for foreign participation. To the south, along Flushing Creek lies the section given over to the States, and northerly, still on the waterway, are placed Horticulture and the Shelter group.

Given the major elements of the plan, there arose the related problems of water supply, sewers and drainage; electric lines for distribution of light and power; landscape treatment, planting of trees and building of roads. All of these services and facilities for the temporary City had to be set up long in advance of definite information as to the number of participants who would be expected and on an estimated attendance. It was accepted as an established basis for computations that an acre of ground developed and built upon might be expected to accommodate, indoors and out, with comfortable freedom of movement, a total of 1,000 persons. It was further estimated from statistics derived from previous fairs, such as the Century of Progess at Chicago, the Texas Centennial at Dallas, the Great Lakes Exposition at Cleveland, and the Canadian National Exhibition at Toronto, that given the City of New York as a major attraction in partnership with the Fair and as a center of railroad and steamship service from all points of the world, it could be anticipated that there would be a minimum daily attendance of 250,000, a normal attendance of 500,000 and a maximum attendance, say, of 700,000 to 800,000 persons. Building not for the peak load, but for a reasonable, normal attendance, it was proposed to develop for public access approximately 600 acres, out of the available 1200, and to place upon the remaining area the water-gate, great parking spaces, railroad extensions and stations and park-like circulation and landscape treatment suitable to the ultimate use of the site after the Fair, as Flusing Meadows Park.

While this plan, as submitted with the report of the Board of Design established the form, circulation and treatment of the developed areas, it did not attempt to do more than indicate, in an illustrative manner, the types and placing of buildings, whether built by exhibitors for their private use or by the Fair for the rental of space to participants.

The types of buildings in which space would be rented to private exhibitors were determined only after careful study of the experience in connection with similar projects throughout the world. The controlling thought was that there must be a logical placing of exhibit space in relation to broad aisles of circulation, giving full freedom for passage as well as for viewing the exhibits. It was accordingly agreed that buildings should be either of a width approximating 60 feet with a single broad central aisle and exhibit spaces on either side, or of an overall width of approximately 110 feet with exhibit spaces toward the outer walls and two broad lines of circulation having an exhibit island between them, or a combination of elements of these widths.

Over twenty such buildings have been put under construction or made ready for contract, and a number of these and other buildings for Fair use may be seen in the aerial view of the site as it appeared in January of this year. Figure 3.

The final step in the report was the construction and operating budget. Throughout the growth and use of our short-lived City, income and outgo must be offset and none will be content unless there is after the dismantling a substantial surplus. Capital cost including design, construction and administrative expense are the first causes of present outlay. This will be covered by a bond issue already sold, giving the Fair Corporation the funds necessary to make ready for opening the gates on May 1, 1939.

Income thereafter will come from many sources, four of which are of major importance. The "gate" is the chief of these. Admissions will total more than 40,000,000 for the first year,—if the Fair is open for two years, perhaps 60,000,000. Rentals will be next in importance,—rentals for ground space leased to exhibitors who will erect their own buildings and rentals for floor space taken by exhibitors in Fair-built buildings. Participation in the business of concessions within the Fair will bring the Corporation some additional millions of dollars, and reimbursement of services rendered and other sources of revenue will add to this income.

All told it is expected that dollars taken in before the official opening and during the period of operation, will be more than sufficient to meet all construction costs, maintain and operate the Fair, pay all insurance and interest charges and retire the bonds. The project is being carried out on a business basis and the outlook is good for its complete success.

When finally the gates close and the temporary structural features have been removed, the site will be cleared to a level 4 feet below grade and reconstructed as Flushing Meadows Park, a beautiful addition to New York City's parks and parkway system sitting upon what was once the water-soaked bog through which meandered the lazy waters of Flushing Creek.

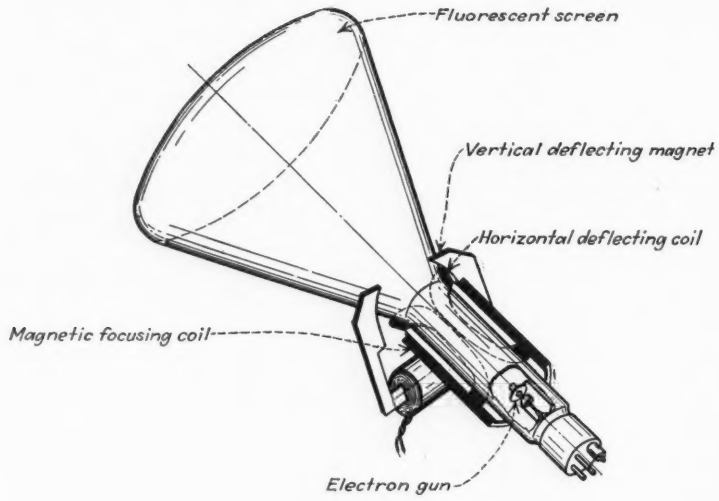


FIG. 4

Simplified Cathode Ray Tube Setup For Use As Oscillite In Farnsworth Televisi Receiver

(*Continued from page* 147)

broadcasting stations. It is more than obvious that space to accommodate even one television station cannot be found in the present broadcast band. Thus it has been found necessary to remove television radio to the ultra-high frequencies beyond 30 megacycles (wave-lengths lower than 10 meters). Experiments are being carried on in this territory at the present time to determine just what frequency assignments are most satisfactory.

Since television signals require such a wide band for satisfactory operation, the important link in the chain, the video amplifier must be capable of handling this broad band of frequencies. Amplifiers which will pass a band with an upper limit of 2500 kc. will satisfactorily handle video signals. The present standards for television provide for a frame frequency of 30 frames per second so that the amplifier must pass frequencies as low as 30 cycles per second.

The video amplifier has also another job to perform. It must pass transients of current due to synchronizing impulses and blanking pulses. Both of these are super-imposed upon the transmitted signal, the synchronizing pulse to keep the receiver in step with the transmitter and the blanking impulse to remove the objectionable traceback of the cathode ray as it returns from the end of the frame to the beginning. Since these pulses are of a transient nature, the amplifier must be of such a type as to preserve their wave-form correctly. Thus the phase delay must be the same for all frequencies so as to prevent distortion of these pulses. Figure 1 shows a typical pulse and distortion of that pulse. Figure 2 shows a video amplifier which is capable of effectively passing the pulses and the video signal correctly.

The present television system is a costly affair due to the complex and extended circuits required to transmit and receive the video signal properly. In Figure 5 is shown a block diagram of a typical video receiver, and Figure 6 shows a diagram of a complete television studio layout. These diagrams give an indication of the complex nature of the modern system for transmission and reception of a television signal.

And How Soon——?

Just how soon television will put in its commercial appearance can not be determined at the present time. The principal technical difficulties have been solved. Television is more than ready to leave the laboratory. Large and satisfactory pictures can be received, and simplified controls for the layman have been evolved. Even studio technique has been studied. Certain economic questions have not, however, been answered to the satisfaction of all concerned.

In the first place, the ultra-high frequencies demanded by television have certain traits peculiar to the species. They are useful only up to a maximum range of 25 to 40 miles. They are absolutely dependable only within the line of sight. Thus a television

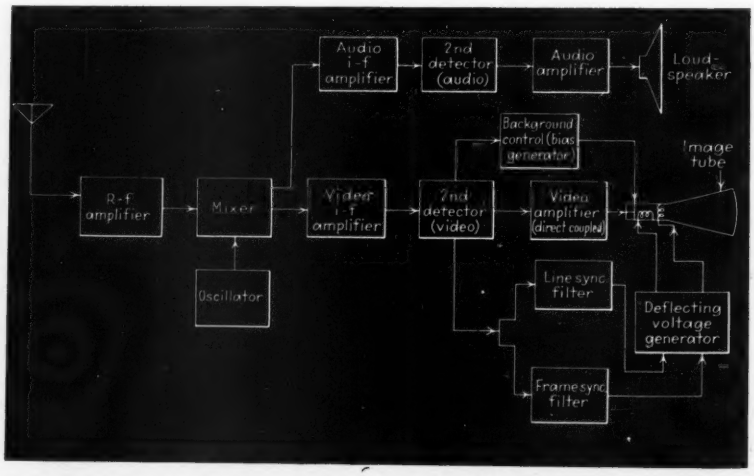
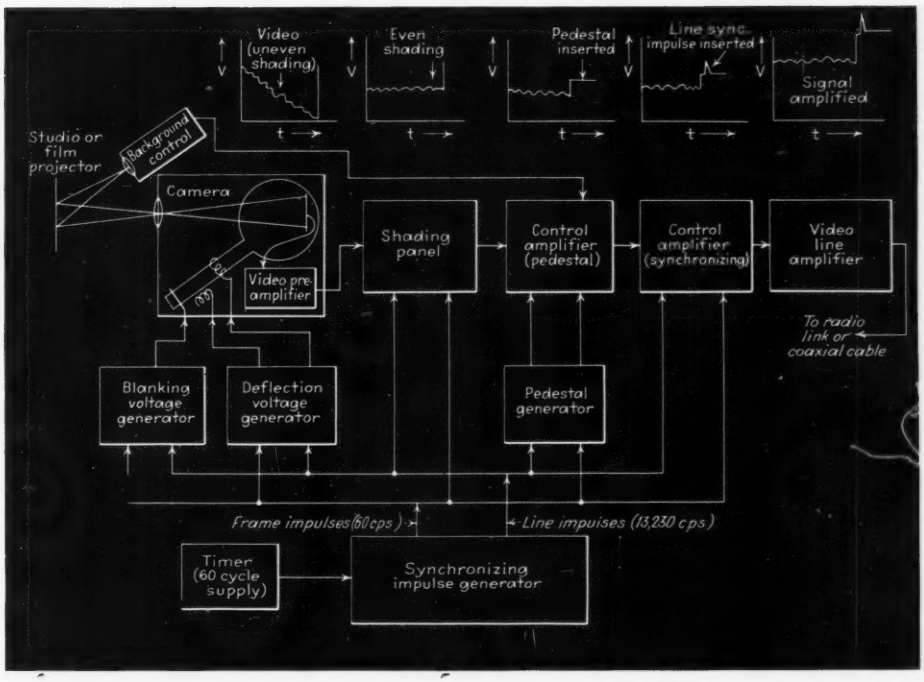


Fig. 5—Video And Audio Elements Of Typical Television Receiver. Average Illumination Of Picture Is Controlled By Bias Value Obtained From The Second Detector.

transmitter in New York City would be able to serve only the immediately surrounding city area. To cover the nation with a network in the same manner that it is covered by broadcasting would require a tremendous number of stations far out of proportion to the population served. Obviously someone must pay for this service and a way to get it paid for must be found before such service will be obtainable forming a vicious circle with the theme —no service, no customs; no customers, no service; and bring your own aspirin after this.



Cuts Courtesy Electronics Magazine

Fig. 6—Pickup And Control Equipment Used In Typical Television Studio. Waveforms Show Changes Undergone In A Signa lRepresenting A Single Line Of The Image.

The next factor to be considered is that of linking the various transmitters together if chain broadcasting is to be accomplished. Here another peculiarity of television presents itself. Sound transmission can be carried quite adequately on ordinary high stability telephone lines. Video signals, on the other hand, with their requirement of a large band-width, must be transmitted between cities only by a special coaxial cable or by means of relay stations. It is a strange anomaly of radio fate that television, requiring a much more extensive cross-country network than broadcasting, is much less capable of fulfilling its requirements. Covering the nation with a network of coaxial cables and relay stations would be an extremely expensive undertaking, and television sponsors are rather doubtful of the possibility of the plan.

And then, of course, there is the small matter of cost of receiving equipment. Calculations at the present time suggest an initial cost of between $200 and $600 for an ordinary home receiver (with a probable minimum of 20 to 30 tubes).

What Is Being Done

The United States and certain European nations have been hard at work in the past two years developing the technical side of television. Backed by government subsidies, English, German, and Italian companies have not only been experimenting with transmitting and receiving equipment but have also attempted actual broadcasting schedules. American engineers visiting abroad have been impressed with the television transmitters and studios developed in foreign countries.

They have also been greatly impressed by the startling lack of enthusiasm towards television displayed by Mr. Average Citizen, of Europe. This is largely due, they suspect, to the fact that Mr. Citizen's pocketbook is not lined with the coin of the realm, and he and the engineers have not yet reached a meeting of the minds in the matter of receiving set prices. Organizations abroad, engaged in purveying television to the public, are the British Broadcasting Company in London, and Telefunken, and Fernseh A. G. in Berlin. In this country, RCA, NBC, CBS, Philco, Farnsworth Television Corporation, and the Don Lee Broadcasting Corporation are actively engaged in promotion of television. A.T.&T. has been experimenting with transmission of video signals over coaxial lines and has installed a complete coaxial system bteween New York and Philadelphia which has thus far been giving excellent results in experimental wide band service.

And its anybody's guess as to when television will actually arrive in the home. In the meantime, why not figure out a good name for the new branch of radio? You might logically follow in the footsteps of poet Stephan Phillips, who wrote in 1900:

"And we studied Western Europe from the Tiber to the Taff
With his polychromotelepantophotophonograph."

COLLEGE NOTES

COLLEGE OF ENGINEERING DINNER

Appointment of the faculty committee to make plans for the annual College of Engineering dinner in Willard Straight Hall Tuesday evening, March 29 has been announced. Professor M. A. Lee of the Sibley School of Mechanical Engineering is chairman. Other members are Professor B. K. Northrop of the School of Electrical Engineering, Professor S. G. George of the Civil Engineering School, and C. C. Winding representing Civil Engineering. Dexter S. Kimball, former dean of the College of Engineering will be the principal speaker.

A.S.M.E PUBLIC SPEAKING CONTEST

George C. Brainard, '38 ME won the first prize in a public speaking contest at the last meeting of the student branch of the A.S.M.E He received a book prize for winning the contest and will represent Cornell in May at the regional A.S.ME contest at the University of Vermont. The subject of his speech was "Problems Encountered on Conveyor Lines". Second prize was won won by C. Monroe Albright, Jr., '38. Other competitors were Henry C. Day, '38, Richard W. Marchant, '38, and Edward V. Dorr, '38. They were judged on the content of the speech and the delivery. Judges were Professor Barnard, director of the School of Mechanical Engineering, Professors F. O. Ellenwood, S. S. Garrett, and F. S. Rogers, and W. G. Jones, '38, W. L. Bohner, '38, and F. M. Huntington, '38.

TELL BERNA SPEAKS

Tell Berna, '12, one of Cornell's great track stars of former years, gave a talk February 25, before students of the College of Engineering as the representativ of one of this country's important industries. As general manager of the National Machine Tool Builders Association, with headquarters in Cleveland, and former sales manager of the National Acme Company of Cleveland, Berna is well qualified to discuss the problems of industry. He spoke to sophomores and seniors in Mechanical Engineering, Electrical Engineering, and Administrative Engineering. His subject was "Why the Machine?" and "Machine-Made Jobs."

Berna was intercollegiate cross-country champion in 1909, and in May, 1912 set a two-mile outdoor record that stood as the American mark until 1934.

NEW A.E.M.E COURSES

Beginning next fall there will be two new courses offered in the AE-ME curriculum. Human Nature and Management and a course designed as "the final or crowning part" of the whole Administrative schedule to be known as The Capstone Course.

Human Nature and Management will be given by Professor John R. Bangs, Jr. This course will be modeled after similar ones given at MIT and Yale, which are the only other two courses dealing with Human Nature given in this country. Professor Bangs plans to take up many interesting situations which arise from time time between executives and the men under them.

The Capstone Course will be given by Professor S. S. Garrett and is designed primarily for the purpose of tying together in the student's mind the work he has done in other courses. This will fall in line with Professor Bang's theory of "Engineering through to the end", in that it will combine and coordinate the material given in previous courses in the manner of solving actual problems of industry and business.

CHINESE ENGINEERS MEET

A meeting of the Cornell Chapter of Chinese Institute of Engineers was held in Room 21, Lincoln Hall, on February 19th. Professor L. C. Urquhart gave

an instructive talk on "Building Construction, and Engineers in Building Construction." After the lecture, refreshments were served, and the members asked questions, which Professor Urquhart answered in an interesting manner. In every way the meeting was successful.

Chen-Hsu T'ang, M.C.E. '37 McGraw Fellow in Civil Engineering, was re-elected president of the chapter for the second term of the school year 1937-38; Cheng-Hsi Shi, Grad., secretary; Shih-Jui Raymond Wang, '38, treasurer.

During the latter part of March the chapter will make an inspection trip to the glass works at Corning.

MR. DAVIS GIVES DEMONSTRATION

In a recent lecture, Howard L. Davis, director of technical employment for the New York Telephone Company, demonstrated an employer's method of interviewing applicants for jobs. G. C. Brainard, '38ME, E. E. Hughes, '38 AEME, and D. F. Sanders, '38EE were interviewed on the platform by Mr. Davis. At the close of the demonstration he analyzed the interviews, pointing out both their strong and weak points. Mr. Davis is the author of "The Young Man in Business" and "Preparation for Seeking Employment". He is a regular lecturer in the course "Introduction to Business and Industry" in the College of Engineering.

LOWELL CHAWNER TALKS HERE

Lowell J. Chawner, chief of the construction economics section of the U.S. Department of Commerce, recently gave a lecture here on "Construction Economics". The lecture was given before a group of engineering students. He explained the relation between the fluctuation in the amount of construction and changes in business earnings. He also referred to other changes which caused these construction cycles. Mr. Chawner was formerly a graduate student and an instructor in structural engineering in the School of Civil Engineering.

The Neches River Bridge.

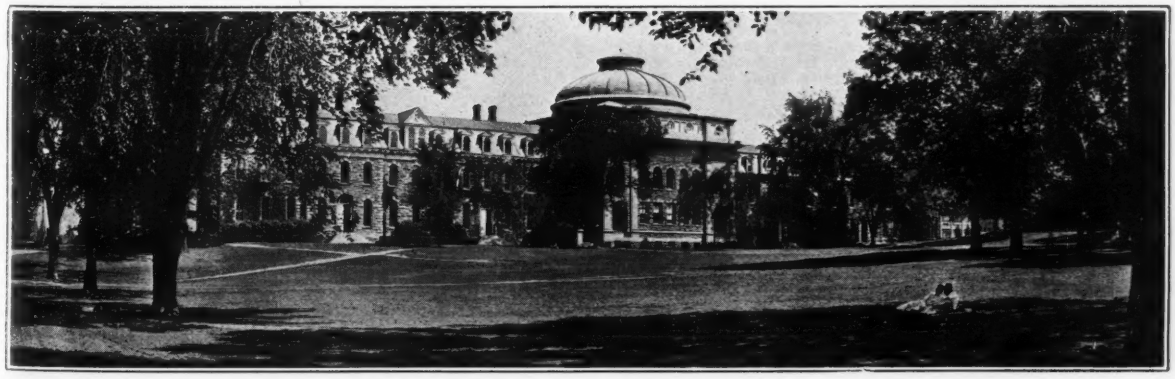
MR. TAMMEN SPEAKS AT A.S.C.E. MEETING

Mr. Henry C. Tammen gave a lecture on "The Neches River Bridge" at a combined meeting of the Cornell Student Chapter and the Ithaca Section of the American Society of Civil Egineers, on February 24. The Neches River Bridge, which is being constructed six miles northeast of Port Arthur, Texas, was designed by his firm of consulting engineers. He showed slides of the architectural and engineering layout of the bridge as planned and as it was constructed. Mr. Tammen discussed the effect on the design and construction caused by the low marshy land on each side of the 1,000-foot wide river, the necessity for allowing ocean ships to pass, and the possiiblity of hurricanes. He also pointed out various details of the bridge and the methods used in building it which make it unique. Following the lecture, refreshments were served and the discussion proceeded informally on various subjects.

Preceding the lecture, a combined dinner meeting of the Student Chapter and the Ithaca Section was held at Willard Straight. Mr. Stickney, of Binghamton, President of the Ithaca Section, presided at the meeting. He explained the new boundaries of the area covered by the Ithaca Section.

Mr. Tammen was the guest of the Pyramid Society at a luncheon meeting attended by student members and professors in the Civil Engineering School.

(*Conutinued on page* 172)



Do You Know These Men?

DAVID HOWELL BROWN

It is quite a problem to find time to seriously participate in an endeavor as exacting as music, strive for your letter in a major sport, and keep a really good scholastic record in the Sibley School of Mechanical Engineering. Yet David Howell Brown '38 M.E. seems to be able to find the time, and also supply the ability that is needed, for he heads his class this year and has a formidable list of honors and activities to his credit for the four well spent years at Cornell.

It is easy to see that his music has formed an important portion of his college life, for he has been Concert Master of the University Symphony Orchestra for three years, a member of the Musical Club, which is the honorary musical society, and student leader of the Instrumental Club. When the Spiked Shoe Society honors John Moakley at their annual Open House, Dave leads the musical side of the program.

Dave has been on the track and cross country squad for four years. Just prior to the recent Triangular Track Meet, Dave mentioned that he has been pointing toward a letter in track for some time and really expects to win it this year. After seeing him take a well earned third in the half-mile, we know he'll make it.

Dave, who lives in Cedar Rapids, Iowa, wanted a good Engineering school somewhere east of Iowa, so he chose Cornell. After graduation, he will enter the training course of the Standard Oil Company of New Jersey, having already spent a summer in the Socony Vacuum machine shop in Olean.

A member of Sigma Phi fraternity, Dave has made Tau Beta Pi, Atmos, Phi Kappa Phi and Quill and Dagger honorary societies and Red Key Junior Society in addition to his musical and athletic accomplishments.

JACK WILCOX GAUL

Engaging in a well rounded combination of activities has been the history of Jack Wilcox Gaul, '38 C.E. at Cornell. Coming from Nichols Prep in Buffalo, where he played football, captained the tennis team and was active in publication work, Jack has made the honorary societies in Engineering and in Civil Engineering, while whole heartedly enjoying the social activities that are a real part of his idea of an education.

Apparently, Jack forsook the athletic field for the chairman's platform when he came to Cornell, for he is President of the Student Chapter of the American Society of Civil Engineers, Vice-president of Pyramid Society and President of his fraternity, Delta Upsilon. His sense of humor stands him in good stead here, and he enjoys the work as officer in student affairs most. The straight Civil Engineering course appealed most to Jack, and he explains why. With the extensive loop courses given to graduates by engineering firms, specialization in college is often lost effort and prevents one from receiving the right foundation. He admits, however, having a tendency towards the construction field,

In addition to the required summer C.E. camp, Jack has worked in the Telephone Co. and traveled in Europe during his college summer vacations. He hopes for the chance to travel more extensively, but fears that the young engineer's important years are just ahead and not likely to yield such a chance.

Jack strongly believes in getting his work done competently and with a high standard of perfection, but he claims his right to good, honest fun is inviolable. These opinions are no doubt his working principals, as Jack is a member of Tau Beta Pi and Chi Epsilon as well as a full-fledged, red-blooded member of Kappa Beta Phi.

ALUMNI NOTES

A little incident which happened during the Penn Game on Thanksgiving Day brought to mind one of the many little services that a good up-to-date Alumni Department can be. While making my way down an aisle towards the field, I was deposited on the step along with another who was apparently in too much of a hurry to retain balance. The gentleman got up and commenced profuse apologies, knowing well he would be fully pardoned by the addition of "I'm a Cornellian too, an 'Old Grad of 1929'."

It is the idea of a graduate of 1929 calling himself an "old grad" that reminds me of the men who have been out just a few years (his eight years are but a few years) and their portion of the Alumni News.

When graduation splits up a group of our engineers who have come to know one another, most men wish to keep track of friends and acquaintances who go into many parts of the world and various positions. Very few of us keep up many regular correspondences during this very busy time, and when we pause one day to discover where to write a particular chum, finding his whereabouts is not so easy. On the other hand, if we have read an Alumni Note in the Engineer about his first transfer of office a year or so after graduation, the chances are great that we can remember and can look him up in that issue.

You "old grads" of recent years, won't you drop us a card with your position, year, address, present sports or avocations, etc., if you don't think there's more to report at present. You might find that Yan K. Sweep, who could only row at school, has taken up squash at the Cornell Club in your town and would enjoy a chance to beat you.

The address is Alumni Editor, CORNELL ENGINEER, Cornell University.

'97 ME—Alfred Hurlburt is vice-president in charge of operation for the Republic Natural Gas Company, Corpus Christi, Texas. He writes, "Busy developing gas and oil in Kansas, Oklahoma, Texas, and Louisiana, and at this season of the year enjoying the warm climate, but always looking forward to see the hills and enjoy the country and associations of New York and Pennsylvania."

'04 ME—Andrew A. Holmes is with the United States Potash Company, Rockefeller Center, New York City. His home is at Wykagyl Gardens, New Rochelle.

It is not surprising to find that each year, quite a number of the boys entering the engineering college are sons of Cornell engineers. This year, thirty-three of the two hundred and seventy-two freshman engineers are sons of graduates of the engineering college. There are a number of others whose fathers were in other colleges of the university. These are the alumni, together with their sons who are freshmen this year:

'98 ME—George W. Vreeland—George W.
'04 CE—Harry N. Howe—Warner
'04 ME—Mayo E. Roe—Mayo E.
'04 ME—Daniel Ransom Scholes—Fraser
'06 ME—Craig Adair—Craig
'06 ME—Chandler B. Brian—John Chamberlin
'06 ME—Edward T. Foote—Peter C.
'06 CE—Ralph Shreve—Thomas Charles
'07 ME—Frederick Munschauer—Frederick
'08 ME—Max Davis—Stanley
'08 ME—Walter E. Flickenger—William C.
'08 ME—John Washburn Holt—John Washburn
'09—Arthur Carl Amsler—Frederick D.
'09—W. Van Alan Clark—Hays
'09 CE—Otto V. Kruse—Raymond W.
'10 ME—Wilbur Hart—Wilbur
'10 ME—Henry D. Lindsay—Henry D.
'10 ME—Everett Alfonso Phillips—Everett Alfonso
'10 ME—Leland W. Riggs—Edwin W.
'10—John Jacob Serrell—Victor E.
'10 ME—Arthur F. Tydeman—Arthur F.
'10 ME—Stanley Victor Wood—Charles R.
'11—Manuel F. Galdo—Manuel José
'11 ME—W. Fairfield Peterson—Walker F.
'11 ME—George Hauer Zouck—Robert L.
'13 ME—Raymond S. Ackerly—Robert Allen
'13 ME—Morris Bradt—David Morris
'13—Richard A. Dittmar—Richard A.
'13 CE—Walter K. Shaw—Walter B.
'15 ME—Walter H. Stocking—James W.
'16 ME—Peter Hoffman Birckhead—Lewis M.
'16 ME—Otto de Lorenzi—Otto
'18 ME—Shurly R. Irish—Shurly R.

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•

"The objects of this Society are to promote the Welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Column

March 5, 1938

FELLOW ENGINEERS:

Last month this letter column mentioned the value of putting one's best foot forward in applying for engineering work. This month a few remarks will be made in regard to maintaining a position after it has been procured.

The employer places responsibility upon those of his assistants who indicate qualities of dependability and likelihood of development. The well run office continuously transmits problems to the engineering force for solution, leaving the head to think of policy, organization, progress, and like subjects. The young engineer, who, upon being assigned a task, properly analyzes it and produces a reasonable and practical answer, is going to be given more and more responsibility and his reputation, that is, his position, is going to be advanced.

On the other hand, the young engineer who fails to understand the problem when given him, puzzles over it for long hours, returns for directions and conditions he should have obtained in the first place and reaches a conclusion based upon theories which will not stand analysis, is likely to be looked upon with uncertainty by the employer and less and less responsibility will be imposed on him.

An article well worth reading by the undergraduate appeared in "Civil Engineering," December, 1936, on "What an Employer Looks for in a Young Engineer." Mr. Eddy, the author, as a result of his very broad experience, mentioned the following qualities the young engineer should have or should develop:

Aptitude for engineering.
Capability.
Broad foundation of engineering education more so than specialized knowledge.
Initiative and imagination.
Originality, ingenuity and ability to solve engineering problems.
Judgment or common sense.
Dependability.
Self-assurance, that is—a tenacity of opinion until proved to be wrong.
Personality, that is—agreeableness and pleasantness of temperament.
Health and the proper care of it.
Appearance—neat in person and in dress.
Experience, that is—ability to learn and remember office methods and type of work done by the organization.
Leadership, that is—willingness to head a cause or delegation or to take part in affairs in and out of the office.
Culture, or versatility—knowledge of a number of subjects outside of one's particular profession. (The author thinks that these should rate among the most important qualities.)

All of these are self-explanatory and self-evident as being of benefit to the young engineer. If he will but put himself into the place of the head of his organization and review abilities of himself and his fellow works, he will quickly see how important these qualities are in comparison with the mere facts that such and such a man took an engineering degree in so and so university and has had years of experience with the A. & B. Railroad or the C. & D. Mining Company. Such a reverse viewpoint of himself will help to develop these qualities which cannot be learned from books or from a school.

All the qualities a young engineer should have for his job and his enjoyment in life could perhaps be boiled down to the following:

1—Dependability.
2—Ability to think and talk clearly.
3—To get on well with his fellow human beings.

G. J. REQUARDT, *President,*
CORNELL SOCIETY OF ENGINEERS

Telephone lines are planted with plows

RURAL telephone wire—*not in cables*—can now go underground where bad weather and grass fires can't harm it.

To make this possible, an entirely new kind of wire had to be developed. Special insulating compounds, special splicing methods were devised. Then a simple, economical method of burial had to be found. A special plow solved this problem—one that digs a furrow and tucks away the wire in a single operation.

Just one more step in the process of making Bell System service constantly more dependable.

BELL TELEPHONE SYSTEM

Why not telephone home tonight? Rates to most points are lowest any time after 7 P. M. and all day Sunday.

ALUMNI NOTES

'10 CE—Carroll R. Harding is assistant to the president of the Southern Pacific Company. He writes that he is busy this year as the president of the California Golf Club and president of the St. Francis Homes Assoc. His address is 65 Market Street, San Francisco, Calif.

'11 ME—Thomas Midgley Jr., vice-president of the Ethyl Gasoline Corp., delivered the opening speech, "Man-Made Molecules," at Columbia University's centennial celebration of the birth of Charles Frederich Chandler, one of America's first industrial chemists and founder of the Columbia School of Mines.

'12 CE—Frank M. Gurney is City Engineer in Oneonta. His address is 2 Irving Place.

'14, '15 ME—Edward R. Guyer, vice-president of Cribben & Sexton, Chicago, Ill., has been elected vice-president of the Association of Gas Appliance and Equipment Manufacturers.

'26 EE—Archibald R. Stevenson is in the engineering department of the General Electric Co., and lives at 1518 Van Vraken Ave., Schenectady.

'27 ME—Oscar O. Oldberg is research engineer with the Norge Corporation, Detroit, Mich., where he lives at 19451 Canterbury Street.

'28, '29 EE—Wilbur C. Sutherland is an air conditioning engineer, and an announcer over station KDKA, in Pittsburgh, Pa., where his address is 5507 Bryant Street. He was recently awarded the H. P. Davis Memorial Announcer's Award, "Symbolic of top honors among twenty-seven Pittsburgh announcers during 1936". This is the second time in three years that Sutherland has received the award.

'29 CE—Harry W. Crawford is manager of the New Jersey Bell Telephone Company, Jersey City, New Jersey. He lives at 168 Linden Ave., Verona, New Jersey.

'35 ME—George C. Norman, 7 Lorrain Place, Summit, N. J., is in the engineering department of the Buffalo Forge Company, New York City.

'35 ME—John S. Brown, East Norman Avenue, Dayton, Ohio, is sales engineer with the Delco Frigidaire conditioning division of General Motors. He married Jean Hughes of Dayton, Ohio, in June.

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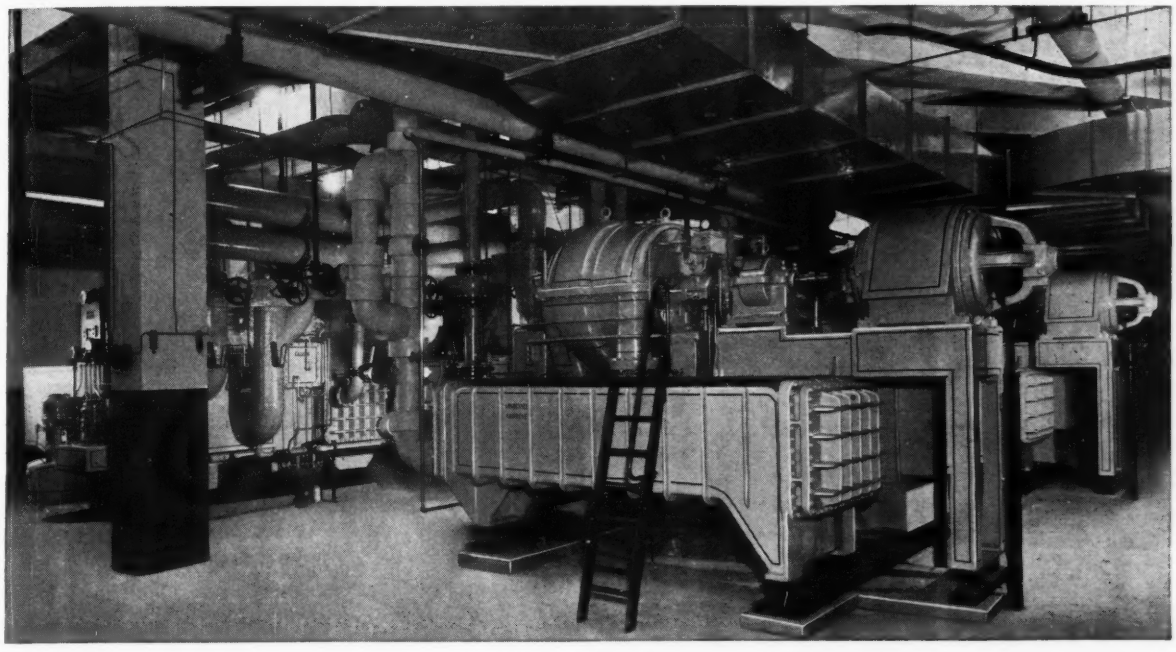

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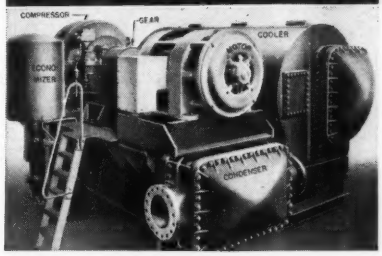
the development that revolutionized an industry!

IT'S a simple matter to provide refrigeration for air conditioning small stores or buildings. A good conventional compressor will do the work in a satisfactory manner, and at reasonable cost. But it's a different matter entirely to supply the thousands of tons of refrigeration required for cooling skyscrapers—or for industrial processing. Space is costly. Power costs must be controlled. Paralleling the trend toward rotating, high speed, smooth-action machinery, Carrier engineers developed Carrier Centrifugal Refrigeration—a development that literally revolutionized the industry!

Think of a compressor capable of supplying cooling equivalent to melting 1000 tons of ice each day—yet so compact that it can be installed in a fraction of the space required for conventional compressors. So economical that power costs are reduced as much as 25%—yet so simple that no skilled attendants are required. So efficient, the first machine constructed is operating today, as effectively as when installed, 15 years ago.

Above: Carrier Centrifugal Refrigeration machine providing refrigeration for air conditioning of skyscraper. *Below:* Diagram of construction.



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Stress & Strain

It has come to light that some members of the faculty are face to face with a problem of great scientific merit. Rumor has it that one of the Instructors in the C.E. School has been working like a 'Hawk' to determine whether Tuna Fish have dials on them.

* * *

Definition of an electron: A very small dot of nobody knows what, that goes like H——backwards from the way that electricity really goes, and then gets all screwed up and loses its sense of direction when the magnetic field is fluxing.

—*Wisconsin Engineer*

* * *

Twinkle, Twinkle, Little Star
Scintillate, scintillate, globule vivific,
Fain would I fathom thy nature specific.
Loftily posed 'mid the ether capacious,
Strongly resembling a gem carbonaceous.

—*Wisconsin Engineer*

* * *

Who is the man designs our pumps with judgment, skill, and care?
Who is the man that builds them and keeps them in repair?
Who has to shut them down because the valve seats disappear?
It is the bearing-wearing, gearing-tearing Mechanical Engineer!

Who makes his juice for half a cent and wants to charge a dime?
Who, when we've signed the contract, can't deliver them half the time?
Who thinks a loss of twenty-six per cent is nothing queer?
It is the volt-reducing, load-reducing Electrical Engineer!

Who is it takes a transit out to find a sewer to tap?
Who with care extreme locates the junction on the map?
Who is it goes to dig it up and finds it nowhere near?
It is the mud-bespattered, torn and tattered Civil Engineer!

Who thinks without his products we would all be in the lurch?
Who has a heathen idol which he designates Research?
Who tints the creeks, perfumes the air and makes the landscape drear?
The stink-evolving, grass-dissolving Chemical Engineer!

Who is the man who'll draw a plan for everything you desire?
From a trans-Atlantic liner to a hairpin made of wire?
With "ifs" and "ands", "howe'rs" and "buts", who makes his meaning clear?
The work-disdaining, fee-retaining Consulting Engineer!

Who builds a road for fifty years that disappears in two?
Then changes his identity so no one's left to sue?
Who covers all the traveled roads with filthy, oily smear?
The bump-providing, rough-on-riding Highway Engineer!

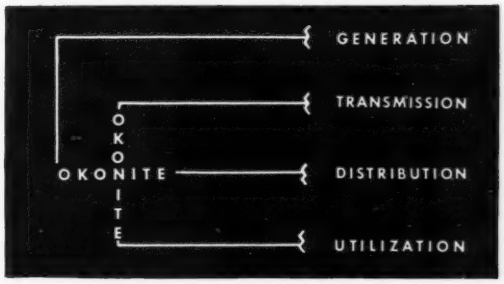
Who takes the pleasure out of life and makes existence hell?
Who'll fire a real good looking one because she cannot spell?
Who substitutes a dictaphone for coral-tinted ear?
The penny-chasing, dollar-wasting Efficiency Engineer!

—Obliging Alumnus

* * *

And of course you've heard of the clothing manufacturer who put out a two-way suit for people who don't know whether they're coming or going.

THE 4-ϕ ELECTRICAL SYSTEM



Okonite Wires and Cables are designed for every condition of use in each of these phases of any electrical system.

A 220,000-volt transmission cable or the smallest control wire may be the vital link in the chain, and seven laboratories in the Okonite factories provide the testing facilities that insure equivalent strength in each link.

There are many bulletins available on Okonite products that will help in solving problems involving insulated conductors.

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Executive Office OKONITE **Passaic, New Jersey**

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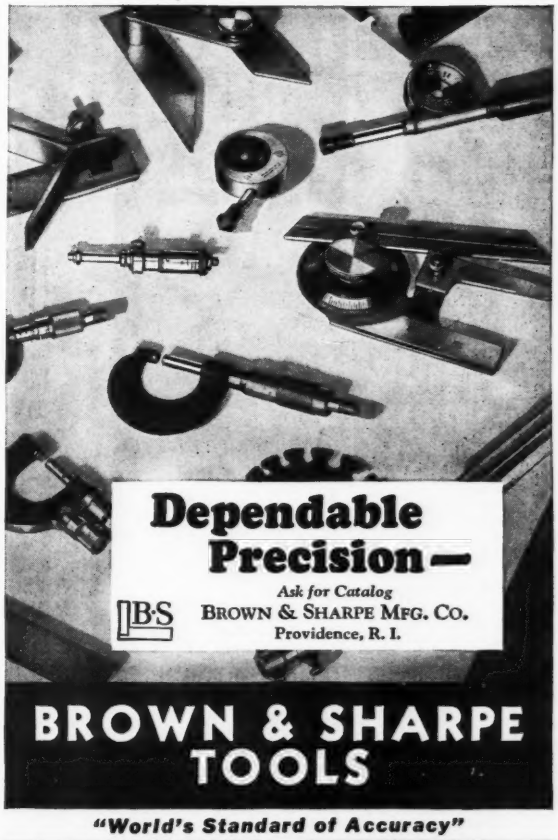

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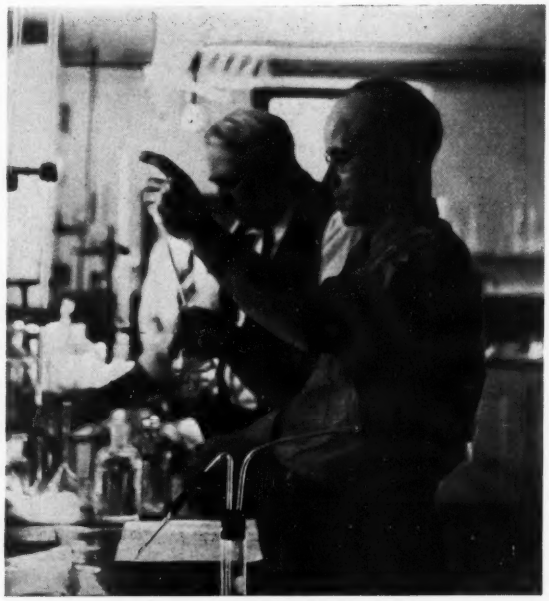
COLLEGE NOTES



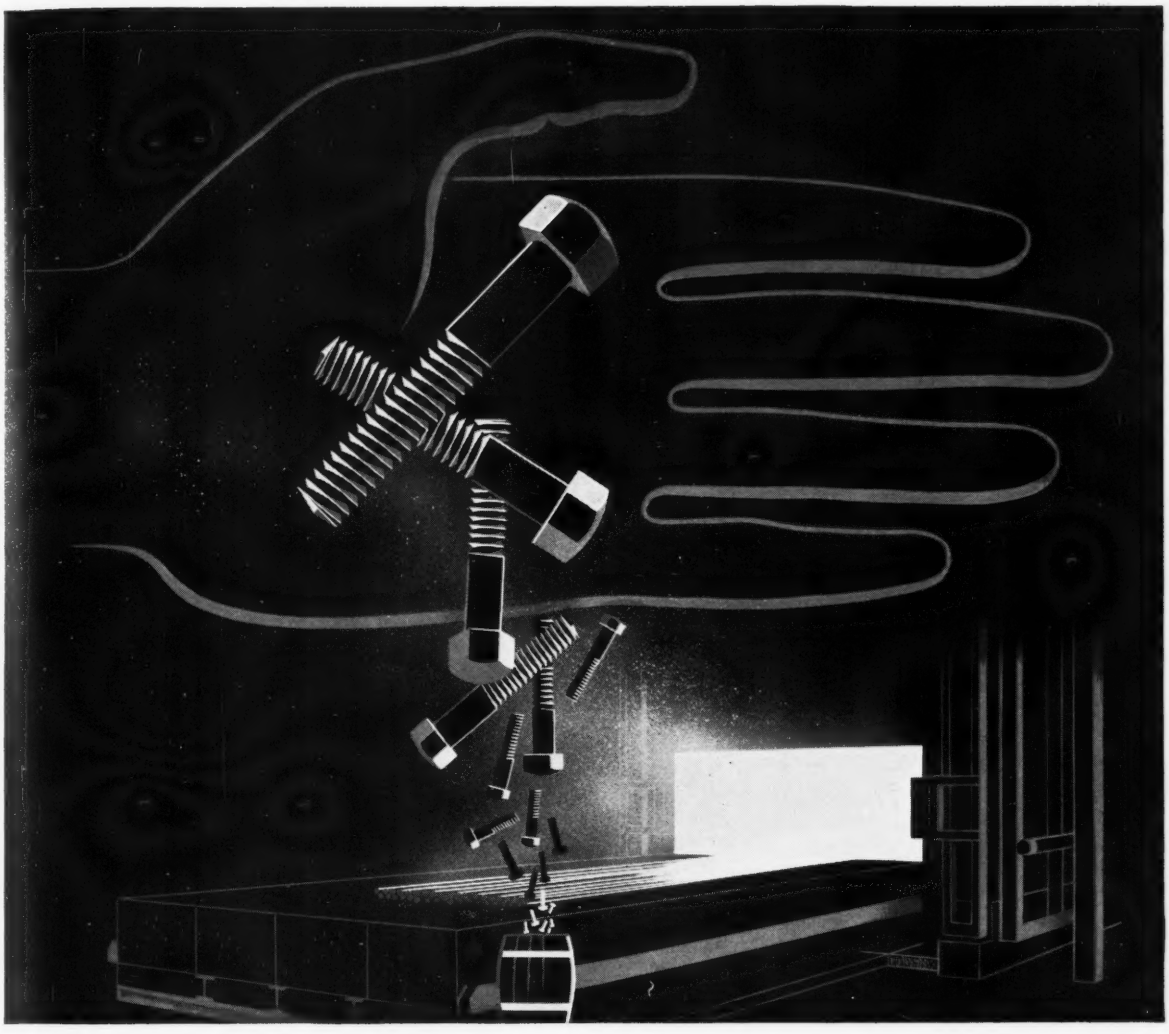
Sewage Works Operators at Work in the Sanitation Laboratory

SEWAGE WORKS OPERATORS SCHOOL

The College of Engineering offered a short course for sewage works operators of the State of New York from March 14 to March 26. The course was approved by the Public Health Council and sponsored by the State Department of Health and the Municipal Training Institute of New York State. Those who completed the course were issued certificates by the Municipal Training Institute to indicate that they had fulfilled part of the requirements for grade I and grade II licenses for operators of public sewage treatment plants, as set forth by an act of the State Legislature on May 25, 1937.

Professors H. N. Ogden, C. L. Walker, and W. E. Stanley of the Department of Sanitary Engineering in the School of Civil Engineering, and Mr. C. C. Agar of the New York State Department of Health gave the course. It consisted of lectures, recitations and discussion periods, solution of assigned problems, and laboratory and demonstration periods. Because of limited laboratory facilities, the course was restricted to ten students, but may be repeated later during the year since there were twenty-two applicants.

A similar but shorter course was given by the School of Civil Engineering in 1932 with the co-operation of the New York State Sewage Works Association, the State Department of Health, and the Mayors' Conference of New York State.



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STEEL of uniform properties is the first key to a uniform product and to steady, economical production.

By using Chrome-Moly steel (SAE 4140), a manufacturer was able to heat treat ½" to 2" bolt stock in tonnage lots and still hold physical properties to close and difficult specifications. What's more, the steel was machinable enough after heat treatment to allow thread-cutting with a standard automatic die-head.

Uniform response to heat treatment is but one of the many qualities of Moly steels that help to simplify production problems.

Any engineering or production head interested in turning out a better product at lower cost will do well to look deeply into Moly steels and irons. Our technical book, "Molybdenum," is free for the asking. Climax Molybdenum Co., 500 Fifth Ave., New York.

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G-E *Campus News*

"SOUPED" ENGINES FOR SIX-MILE HEIGHTS

AS THE bellows is to the forge, so is the supercharger to the airplane engine. Because of the rarefied atmosphere at high elevations, airplane engines require superchargers which operate like fan blowers, maintaining air pressure in the engines and permitting the motor to operate at normal efficiency.

Today, twelve-hour flights from coast to coast at an average height of six miles are the objective of transport airlines. Experiments in this field have been successfully conducted by Transcontinental and Western Air, Inc., and the U.S. Army Air Corps with very encouraging results, using G-E turbine-driven superchargers.

Military, transport, racing, and transoceanic planes are equipped with G-E superchargers which increase motor efficiency, speed, and flying distance. The superchargers were developed by Dr. S. A. Moss, of General Electric and are built in the River Works in Lynn, Mass. Student engineers on Test at Lynn have an opportunity to inspect and test these devices as a part of their training course.

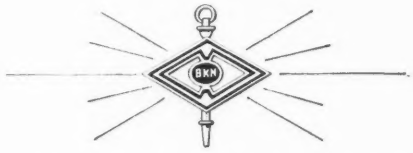
BEATING SWORDS INTO PLOWSHARES

WELL, not exactly swords into plowshares, but rather discarded rails, superheaters, and boiler tubes into steel for the overhead system of an electrified railroad line. In this manner the old steam railroad of the Witwatersrand Gold Mining Area was replaced by a completely electrified line.

Because of the rise in gold prices during the last few years, an increased suburban passenger traffic in that section of South Africa necessitated an enlargement of the railroad.

Mercury-arc rectifiers made by the British Thomson-Houston Company, an affiliate of General Electric, supply the power for the "Reef Scheme," as it is called, while 115 four-motor, multiple-unit car equipments were furnished by G.E. through the International General Electric Company.

The engineering and sales work on this project was done by several former G-E Test men. Many such opportunities are open to graduates of college engineering schools who have successfully completed the G-E Test Course.



AMERICA'S OUTSTANDING YOUNG ELECTRICAL ENGINEER

DR. CHAUNCEY GUY SUITS, research physicist of the General Electric Research Laboratory, in Schenectady, has been named by Eta Kappa Nu, honorary electrical engineering fraternity, as the outstanding young electrical engineer for 1937.

Born in Oshkosh, Wisconsin in 1905, Dr. Suits graduated from the University of Wisconsin in 1927 and from the Technische Hochschule in Zurich, Switzerland (Sc.D. '29). An ardent skier, he spends most of his spare time on the snowy slopes around upper New York State.

As a member of the Research Laboratory staff, his work has been on the fundamentals of electric arcs, showing how arc temperature can be measured by sound, and it was for this work that the Eta Kappa Nu award was given him. Other activities for which Dr. Suits is noted include the investigation of non-linear circuits, high-pressure arcs, and the development of automatic tuning for radio receivers.

Last year the award was given to Frank M. Starr, U. of Colorado '28, G-E Test '29, who is employed in the Central Station Engineering Department of General Electric. The Test Course, of which Starr is an alumnus, provides a practical education supplementary to the theoretical knowledge obtained in college.

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